REMARKS

Reconsideration and allowance of the subject application are respectfully requested. Claims 1-52 are pending in the present application, claims 1, 22, 30, 34, 38, and 41 being independent. Claims 44-52 have been added to more particularly define the invention.

Specification Objection

The specification stands objected to because of minor typographical informalities. Applicants direct the Examiner's attention to the amended specification replacing "materia" with "material" (page 11, line 15), replacing "isobuthane" with "isobutene" (page 6, line 23), and replacing "cathode 37" with "cathode 17" (page 8, line 4). In view of the above, Applicants respectfully request reconsideration and withdrawal of the outstanding informality objection concerning the specification.

Drawing Objections

The drawings have been objected to because Figure 5 fails to show element 89. Applicants direct the Examiner's attention to replacement of item number "99" with "89." Accordingly, Applicants respectfully request that the Examiner reconsider and withdraw the drawing objection.

Claim Objections

Claim 7 stands objected to for a minor typographical informality, specifically reciting "isobuthane" instead of "isobutene." Applicants have amended claim 7 replacing "isobuthane" with "isobutene" addressing the informality and assert that amended claim 7 is allowable.

Rejection Under 35 U.S.C. § 112, Second Paragraph

Claims 6, 7, 12, and 13 stand rejected under 35 U.S.C. § 112-second paragraph as being indefinite for failing to particularly point out and distinctly claim the subject matter, which Applicants regard as the invention. This rejection is respectfully traversed.

The Examiner alleges that the phrase including the term "optionally" is indefinite in claim 6, thereby rendering that claim and dependent claim 7 indefinite. Additionally the Examiner alleges that claim 12 has both broad and narrow limitations related to the CCD-based detector making this claim indefinite.

Applicants direct the Examiner's attention to amended claims 6 and 12, removing "optionally" from claim 6 and removing reference to a CCD-based detector in claim 12, overcoming the concerns raised by the examiner without narrowing claim scope. In view of these changes Applicants respectfully request reconsideration and withdrawal of the outstanding rejections under 35 U.S.C. § 112, second paragraph.

The Prior Art Rejections Relying on Lacy

Claims 1, 3, 4, 6, 8, 11, 13, 21-23, 27-29, 38, and 41 stand rejected under 35 U.S.C. §102(e) as being anticipated by Lacy (U.S. Patent No. 6,486,468). Claims 2 and 5 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Lacy. Claim 7 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over Lacy in view of Kruger (U.S. Patent No. 5,311,010). Claims 9, 10, 12, 13, 24, and 26 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Lacy in view of Iwanczyk et al. (U.S. Patent No. 5,773,829). Claims 14, 15,

and 25 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Lacy in view of Francke et al. (U.S. Patent Application No. 2001/0040937). Claims 16, 17, and 18 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Lacy in view of Francke et al. (U.S. Pre Grant Publication 2002/0040937). Claims 19, 20, 39, and 42 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Lacy in view of Wong et al. (U.S. Pre Grant Publication 2002/0121603). Claims 30, 31, 34, and 35 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Lacy in view of Nickles (U.S. Patent No. 6,410,919). Claims 32, 33, 36, and 37 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Lacy in view of Nickles further in view of Wong. Claims 40 and 43 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Lacy in view of Wong further in view of Iwanczyk. These rejections are respectfully traversed for the following reasons.

All of the above rejections primarily rely on the Lacy patent. This patent has an effective Section 102(e) date of its U.S. filing date, November 27, 2000. This date is less than three weeks before the priority date of the present application. The attached Declaration of Rolf Fritzon demonstrates a date of conception prior to November 27, 2000 coupled with diligence until the present application was filed on January 3, 2001. Thus, the present application has an invention date prior to November 27, 2000, removing the Lacy patent as a reference against the present application.

Since each of the rejections relies primarily on the Lacy patent, all art rejections are hereby overcome. The examiner is accordingly requested to reconsider and withdraw the outstanding art rejections.

Conclusion

In view of the above amendments and remarks, Applicants respectfully request reconsideration and withdrawal of the formal objections and rejections to the claims, and the rejections based on prior art. Since Applicants have sworn behind the primary reference applied by the examiner, Applicants respectfully request an early indication of allowability.

If the Examiner has any questions concerning this application, the Examiner is requested to contact the undersigned at (703) 205-8000 in the Washington, D.C. area.

Pursuant to 37 C.F.R. §§ 1.17 and 1.136(a), applicant(s) hereby petition(s) for an extension of time for a two (2) month(s) to June 8, 2003 for filing a reply to the Office Action dated January 8, 2003 in connection with the above-identified application

If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies, to charge payment or credit any overpayments to Deposit Account No. 02-2448 for any additional fees required under 37 C.F.R. §§1.16 or 1.17; particularly, extension of time fees.

Respectfully submitted,

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MARKED UP VERSION TO SHOW CHANGES MADE

IN THE SPECIFICATION

The paragraph beginning on page 6, line 18, has been amended as follows:

The ionizable and scintillating fluid, which preferably also shall be a suitable medium for electron avalanche multiplication, can be in gaseous, liquid, or solid phase and comprises typically any of Ar, Xe, Kr, or a mixture therefore, optionally with small amounts of e.g. CO_2, CH_4, C_2H_6 or [isobuthane] <u>isobutene</u> added thereto, to improve the avalanche amplification achievable. If a gas or gas mixture is employed, it may be under pressure, preferably in a range of 1-20 atm. If a solid is employed it is preferably a solidified noble gas.

The paragraph beginning on page 7, line 30 and ending on page 8, line 6, has been amended as follows:

Cathodes 13, 37 and anode 35 are held, during use, at selected electric potentials by means of an electrical power supply device (not illustrated). Preferably, anode 35 is grounded and cathodes 13, 37 are held at respective selected electrical potentials such that a weak electrical field, called drift field, is obtained substantially between cathode 13 and cathode [17] <u>37</u> and a strong electrical field, called avalanche multiplication field, is obtained between cathode 37 and anode 35, and possibly around cathode 37.

The paragraph beginning on page 11, line 10, has been amended as follows:

At avalanche cathode 37 the electrons begin to be accelerated due to the stronger electrical field experienced and they interact with the substance, causing further electron-ion pairs to be produced. Those produced electrons will also be accelerated in the field, and will

interact repetitively with new [materia] material, causing yet further electron-ion pairs to be produced. This process continues during the travel of the electrons in the avalanche region towards anode 35 located at the bottom of the avalanche region, and in such manner electron avalanches are formed.

IN THE CLAIMS

Claims 19, 20, 27, 28, 39, and 42 have been canceled.

1. (Amended) A detector arrangement for detection of radiation comprising:

a chamber adapted to be filled with an ionizable and scintillating substance;

a radiation entrance arranged such that radiation can enter said chamber partly for ionizing said ionizable and scintillating substance, partly for being converted into light therein;

a light detection arrangement for temporally, and spatially resolved detection of some of said light;

an electron avalanche detection arrangement for avalanche amplification of electrons released as a result of said ionization of said ionizable and scintillating substance, and for temporally resolved and spatially resolved detection of said avalanche amplified electrons;

a correlator[ing means] for correlating detected light and detected avalanche amplified electrons, which are derivable from a single radiation photon; and

a signal generator [producing means] for producing a single signal from said correlated detected light and detected avalanche amplified electrons.

6. (Amended) The detector arrangement as claimed in claim 1 wherein said substance is a scintillating medium[, optionally mixed with a medium for enhanced avalanche multiplication].

7. (Amended) The detector arrangement as claimed in claim 6 wherein said scintillating medium is any of Ar, Xe, Kr, or a mixture thereof, and said medium for enhanced avalanche multiplication is CO_2, CH_4, C_2H_6, isobutene[isobuthane], or a mixture thereof.

12. (Amended) The detector arrangement as claimed in claim 1 wherein said light detection arrangement comprises a solid-state based detector [, particularly a CCD-based detector,] for said temporally and spatially resolved detection of said light.

22. (Amended) A method for detection of radiation comprising the steps of:

entering radiation into a chamber filled with an ionizable and scintillating substance partly for ionizing said ionizable and scintillating substance, partly for converting radiation into light therein;

detecting at least some of said light temporally, [and] spatially, and spectrally resolved by means of a light detection arrangement;

avalanche amplifying electrons released as a result of said ionization of said ionizable and scintillating substance, and detecting in two dimensions said avalanche amplified electrons temporally and spatially resolved by means of an electron avalanche detection arrangement;

correlating detected light and detected avalanche amplified electrons, which are derivable from a single radiation photon; and

producing a signal from said correlated detected light and detected avalanche amplified electrons, wherein said signal produced from said correlated detected light and detected avalanche amplified electrons has spatial and temporal resolutions comparable to the spatial and temporal resolutions of the detected avalanche amplified electrons, and a spectral resolution comparable to the spectral resolution of the detected light.

30. (Amended) A positron emission tomography (PET) apparatus for construction of an image of an object containing positron emitting substance, and said apparatus comprising:

a detector arrangement including:

a chamber adapted to be filled with an ionizable substance;

a radiation entrance arranged such that gamma radiation photon pairs emitted in [dependent on] response to said positrons can enter said chamber for ionizing said ionizable and scintillating substance;

an electron avalanche detection arrangement including a matrix of readout elements for avalanche amplification of electrons released as a result of said ionization of said ionizable substance, and for temporally resolved and spatially resolved two-dimensional detection of said electron avalanches;

a processing means coupled to said detector arrangement, said processing means including:

means for matching a pair of detected electron avalanches, which are derivable from a single radiation photon pair;

means for producing a signal from said matched electron avalanche pair;

said means for matching being arranged to repeat the matching for each further detected electron avalanche, and said means for producing being arranged to repeat the producing of a respective signal for each further matched electron avalanche pair; and

reconstruction means for performing a reconstruction process based upon said respective signals as produced by said means for producing, wherein said reconstruction means calculates amounts of emitted positrons from each of an arbitrarily large number of image volumes selected within said object; and

a display unit coupled to said processing means for projecting an image of said amounts of emitted radiation.

34. (Amended) A positron emission tomography (PET) method for construction of an image of an object containing positron emitting substance, comprising the steps of:

entering gamma radiation photon pairs emitted in [dependence on] <u>response to</u> said positrons into a chamber filled with an ionizable substance;

avalanche amplifying electrons released as a result of said ionization of said ionizable substance and detecting <u>in two dimensions</u> said electron avalanches temporally and spatially resolved by means of an electron avalanche detection arrangement <u>including a matrix of readout elements</u>;

matching a pair of detected electron avalanches, which are derivable from a single radiation photon pair;

producing a signal from said matched electron avalanche pair;

repeating the step of matching for each further detected electron avalanche;

repeating the step of producing a signal for each further matched electron avalanche pair;

performing a reconstruction process based upon said signals as produced, wherein amounts of emitted positrons from each of an arbitrarily large number of image volumes selected within said object are calculated; and

projecting an image of said amounts of emitted radiation.

38. (Amended) A detector arrangement for detection of radiation comprising a cathode and an anode between which a voltage is applied, said arrangement comprising:

a chamber arranged at least partially between said cathode and said anode, said chamber being filled with an ionizable and scintillating substance;

a radiation entrance arranged such that radiation can enter said chamber between and substantially parallel with said cathode and said anode, partly for being converted into light therein, partly for ionizing said ionizable and scintillating substance, whereby electrons released as a result of said ionization of said ionizable and scintillating substance are drifted substantially perpendicular to the direction of said entered radiation by means of said applied voltage;

a light detection arrangement for temporally, [and] spatially, and energy resolved detection of [at least some of said] light;

an electron avalanche detection arrangement for avalanche amplification of said drifted electrons, and for temporally and spatially resolved detection of said avalanche amplified electrons, said electron avalanche detection arrangement being oriented such that said drifted electrons are accelerated, during avalanche amplification, in a direction substantially perpendicular to the direction of said entered radiation;

correlating means for correlating detected light and detected avalanche amplified electrons, which are derivable from a single radiation photon; and

producing means for producing a single signal from said correlated detected light and detected avalanche amplified electrons, wherein

said radiation entrance is formed to allow said radiation to be a planar radiation beam;

said electron avalanche detection arrangement includes a plurality of readout elements arranged in an array such that each readout element is capable of detecting avalanche amplified electrons derivable from absorption by a respective transversely separated portion of said radiation entered into the chamber; and

said producing means is adapted to produce said single signal depending on the energy of said correlated detected light.

40. (Amended) The detector arrangement as claimed in claim 39 wherein

[said radiation entrance is formed to allow said radiation to be a planar radiation beam;

said electron avalanche detection arrangement includes a plurality of readout elements arranged in an array such that each readout element is capable of detecting

avalanche amplified electrons derivable from absorption by a respective transversely separated portion of said radiation entered into the chamber; and]

said light detection arrangement includes a plurality of individual light detection elements arranged in an array such that each light detection element is capable of detecting light derivable from absorption by a respective transversely separated portion of said radiation entered into the chamber.

41. (Amended) A method for detection of radiation comprising the steps of:

entering radiation into a chamber filled with an ionizable and scintillating substance partly for ionizing said ionizable and scintillating substance, partly for converting radiation into light therein;

detecting at least some of said light temporally and spatially resolved by means of a light detection arrangement;

drifting electrons released as a result of said ionization of said ionizable and scintillating substance in a direction substantially perpendicular to the direction of said entered radiation by means of applying an electrical field within said chamber;

avalanche amplifying drifted electrons through acceleration of said drifted electrons in a direction substantially perpendicular to the direction of said entered radiation by means of applying an electrical field within said chamber;

detecting said avalanche simplified electrons temporally and spatially resolved by means of an electron avalanche detection arrangement;

correlating detected light and detected avalanche amplified electrons, which are derivable from a single radiation photon; and

producing a signal from said correlated detected light and detected avalanche amplified electrons, wherein

said entered radiation is a planar radiation beam;

avalanche amplified electrons derivable from absorption by a respective transversely separated portion of said planar radiation beam are detected separately by means of a plurality of readout elements as comprised in said electron avalanche detection arrangement;

the energy of said correlated detected light is measured; and

said single signal is produced depending on the energy of said correlated detected light.

43. (Amended) The method as claimed in claim 42 wherein

[said entered radiation is a planar radiation beam,

avalanche amplified electrons derivable from absorption by a respective transversely separated portion of said planar radiation beam are detected separately by means of a plurality of readout elements as comprised in said electron avalanche detected arrangement; and]

light derivable from absorption by a respective transversely separated portion of said planar radiation beam is detected separately by means of a plurality of individual light detection elements as comprised in said light detection arrangement.

New claims 44 to 52 have been added by this response.